

Climate Resilient Farming – Pilot Round

Request for Proposals from New York State

Department of Agriculture and Markets and Soil and Water Conservation Committee

Useful Information for Professional Engineers Retained by Farmers/Others Responding to the Track 1 Agricultural Waste Storage Cover and Flare Systems

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- Q. Does a farm need a professional engineer to design my covered manure storage?**
- A.** Yes, New York State law requires a New York State licensed professional engineer to design the cover and flare system. Some cover companies may provide design/build systems that include the professional engineering design requirement. A list of professional engineers who attend continuing education sessions offered to NYS licensed PEs by Cornell PRO-DAIRY can be obtained by contacting us.
- Q. How much should the engineering/technical services cost to design and verify cover and flare system installation followed design?**
- A.** Design/build systems generally include engineering/technical service fees within the overall cost of the system. These would only then require a New York professional engineer's review and approval ranging from \$500 to \$5,000 depending on the exact scope of the work. For custom designed systems, the engineering/technical services cost may range from \$12,000 to \$25,000 with exact costs depending on project specifics.
- Q. How are the greenhouse gas (GHG) emission reductions best estimated?**
- A.** The GHG emission reductions are best estimated using the Intergovernmental Panel on Climate Change (IPPC) Tier 2 method from the 2006 IPCC Guidelines for National GHG Inventories, Volume 4, Chapter 10:

$$E_{CH_4} = VS \times B_0 \times 0.67 \times (MCF/100)$$

where

- E_{CH_4} = CH₄ emissions (kg CH₄/cow-day)
- VS = Total volatile solids in manure (kg/cow-day)
- B_0 = Maximum CH₄ producing capacity for manure (m³ CH₄/kg VS)
= 0.24 m³ CH₄/kg VS (for dairy cow manure)
- 0.67 = Conversion factor of m³ CH₄ to kg CH₄
- MCF = CH₄ conversion factor for the manure management system (%)

The daily methane emission per cow can be estimated using this equation. The methane conversion factor (MCF) is based on the type of manure storage system and will change

throughout the year as the manure storage temperature changes. Using average typical winter and summer temperatures, average MCF values can be used in the equation to estimate average methane emissions for these 6-month storage periods:

Storage Period	Winter	Summer
Average Temperature (deg. C)	<10	18
MCF ¹ (%)	17	35

¹ Numbers based on liquid/slurry storage *without* a natural crust cover. From 2006 IPCC Guidelines for National GHG Inventories, Volume 4, Chapter 10.

Using these MCF values and a VS of 7.7 kg/cow-day (average for high producing NY dairy cows), manure storages could be estimated to produce 38 kg CH₄/cow (for the winter storage period) and 81 kg CH₄/cow (for the summer storage period).

Q. How is the gas collection pipeline system designed?

A. The gas collection and flare system needs to be sized for a maximum biogas production rate *and* for a minimum biogas production rate.

Quantification of the maximum flow rate is difficult to calculate and, based on information currently available at this time, may be best estimated by using the results from the above equation and considerations made for: 1) biogas can contain a substantial carbon dioxide component (up to 70% of the volume), 2) during higher temperature times the methane conversion factor (MCF) may approach 80% for the manure added, and 3) when the temperature of the manure storage warms, the stored manure can become warmer than the average typical summer storage period temperature used above, which can result in more methane converted. (This is likely to occur in late summer.) During periods when the minimum or over the maximum biogas flow occurs, non-combusted methane will be released. The cover and gas handling system needs to have a safety relief valve designed for emissions that exceed the design capacity. Specific manure and storage characteristics and temperature variables will result in biogas production rates that are difficult to calculate and, based on information currently available at this time, might best be addressed after the system has been in place and operated for a time.

Q. How is the gas handling designed?

A. References are given to the NRCS-NY 366 Anaerobic Digester Controlled Temperature Standard; and although this Standard DOES NOT directly apply to covered manure storages, it can be used as a guide for the biogas collection and handling components associated with covered long-term manure storages in New York State. This includes the requirement for a gas meter, auto-ignition system powered by a battery/solar or direct connection to electrical services, and flame arrester.

Biogas contains both water vapor and hydrogen sulfide, and these two components combined are corrosive. Water vapor can condense so pipes need to be sloped to drain in order to be protected from freezing.

Q. What type of flare should be selected?

A. A biogas flare system should be sized based on the maximum estimated biogas flow rate (see above) and a minimum biogas flow rate to be combusted (note: not all gas may be combusted). Open flares have a lower capital cost, but due to the openness are subject to being blown out by the wind and are more difficult to keep ignited at low biogas flowrates. Enclosed flares have a higher capital cost, but their enclosed design is less affected by the wind and more likely to stay lit during lower biogas flow rates. As a general guide, an enclosed flare is 1.5 to 2 times more expensive than an open flare of the same capacity. Design engineers, whose farm clients are looking to monetize carbon credits associated with covered manure storages, should talk with carbon credit aggregators/verifiers to make sure flares qualify with Climate Action Reserve standards.

Q. How should the methane produced and captured be measured?

A. Two basic types of commercially available meters are recommended for use to measure the total volume of gas produced. These are mechanical meters and thermal mass insertion flow meters. Mechanical meters measure gas flow rates directly and may need temperature and pressure sensors to more accurately measure gas production. These meters require periodic maintenance due to their mechanical nature. Thermal mass meters are generally temperature and pressure compensated thus providing the most accurate measurements. For both types of meters, total gas production is measured and since biogas is not pure methane, samples of the biogas need to be taken to determine the estimated methane produced over time. Systems should include ports for biogas samples to be obtained. Design engineers, whose farm clients are looking to monetize carbon credits associated with covered manure storages, should talk with carbon credit aggregators/verifiers to make sure selected meters qualify with Climate Action Reserve standards.

Q. How is the methane destroyed by the flare determined?

A. Although gas meters and sampling will determine the methane produced, the flare function must be verified to show that the methane was combusted, converting methane with a high impact on climate change to carbon dioxide. Temperature sensors and recording devices on the flare show when the flare is operating. The flame temperature can be used to predict the combustion products.

Q. How is the farm's resilience to a changing climate benefited by the manure cover?

A. Increased precipitation, more severe storms, and frequent droughts are mitigated by the manure storage impermeable cover. All forms of precipitation are precluded from mixing with stored manure. This also reduces the total storage needed, or increases the storage period for an existing manure storage. If the clean water off the cover is stored in a pond it could augment

irrigation or other water demands on the farm. There is an energy savings in not having to haul the precipitation water that is not mixed with manure. There would also be a reduction in the potential for water pollution, as less mass would have to be spread and the spreading times could be more delayed from the precipitation event.